e-Bangi Faculty of Social Sciences and Humanities Universiti Kebangsaan Malaysia
Journal of Social Sciences and Humanities

Volume 4, Number 1, 48-55, 2009
ISSN: 1823-884x
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SOLID WASTE MANAGEMENT BY CONSIDERING COMPOSTING POTENTIAL IN MALAYSIA TOWARD A GREEN COUNTRY

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ABSTRACT

Solid waste disposal has become a serious issue for country and municipal governments throughout the nation. As available landfill space decreases and the cost of siting and building new landfill increases, local authorities are struggling to develop alternative means of meeting the waste disposal challenge. Landfilling is the most widely used method for solid waste disposal in countries with tropical settlement. Landfills have created various environmental problems such as emissions and leachate. The public has become more aware concerning landfill issues such as increasing concern on the groundwater contamination, potential release of toxic gases and odor. A big part of these problems come from organic waste into the solid waste. Municipal solid waste in Malaysia has a large percent of food waste (around 50-60 percent) that makes a lot of problems in disposal methods. It has emerged as a potentially viable means by which local governments can reduce the volume of waste entering landfills by diverting the organic fraction. Composting is a biological process, in which the organic matter is biodegraded by microorganisms under controlled conditions of temperature, moisture content, oxygen, PH and the retention time that can be initiated by mixing biodegradable organic matter with bulking agents to enhance the porosity of the mixture. In this study, a composting plant in Malaysia is considered that uses organic waste from the market (market waste). Five tons organic waste per day is received in the plant, and it is treated by the wind raw composting method. After calculating costs and benefits of this method result shows that total quantitative benefit of this plant is not much higher than a total quantitative cost but this result is just for quantitative parameter. This method has a lot of qualitative benefits such as: reducing the amount of municipal solid waste, transportation cost of carrying municipal solid waste to land fill, emissions and leachate of landfill, increasing life span of landfill and reducing land use. Composting organic materials that have been diverted from landfills ultimately avoids the production of methane and leachate formulation in the landfills regarding to 50 percent of organic waste in municipal solid waste of Malaysia. With removing this amount of waste from MSW with using composting method, not only the environmental problems of land filling can be reduced but also the costs of transportation and other costs of disposal can be reduced by 50%. Because of one of the most important problems in tropical settlement is to find proper methods to dispose of municipal solid waste toward decreasing pollution, producing compost can be a suitable way but expanding of this treatment method in Malaysia closely related to economic governmental supports.

Keywords: *Municipal Solid waste, Compost, Organic Waste, Landfill, Waste Composition*

INTRODUCTION

Cities play a significant role in the environmental and social sustainability of our planet. While urban areas take up only a fraction of the total surface area of the earth the actual land area needed to sustain their food, energy, and waste disposal (Davis 1998).

In other words, cities require much more space than what is inside their political boundaries to produce enough plants or animals for consumption, renewable energy for

operation, space to absorb the air, water and solid wastes of their citizens. The challenge of our earth becoming – and remaining – sustainable will increase in the coming years as the global population both increases and becomes more urban, while planetary space and resources remain fixed (Kavin 2009).

A number of cities in the U.S. are responding to these challenges by actively adopting policies to minimize their ecological footprints. Many cities have already taken steps to reduce their waste outputs. Over the last century, nearly all have built sewer lines and treatment plants to reduce the amount of human waste entering waterways. During the last few decades, many have developed recycling programs to reduce the amount of trash heading into landfills. More recent efforts involve reducing urban demands for natural resources. Some cities are requiring buildings to include more efficient water and electrical fixtures and appliances. Others are changing their government-owned fleets to more fuel-efficient vehicles or those that run on alternative fuels. A few are supporting the development of local agriculture with farmers' markets. Cities are also taking steps to reduce both energy inputs and waste outputs through new land-use policies. Urban solid waste composting is an alternative to the disposal of significant components of the waste stream in sanitary landfills that has attracted interest among a growing number of communities in the United States and Europe (Renkow and Rubin 1996).

Solid waste disposal has become a serious issue for county and municipal governments throughout the nation. As available landfill space decreases and the cost of siting and building new landfills increases, local authorities are struggling to develop alternative means of meeting the waste disposal challenge. Composting has emerged as a potentially viable means by which local governments can reduce the volume of waste entering landfills by diverting the organic fractious. Yard waste currently comprises l8% of total solid waste generated nationally (Surender and Reddy 2007). Currently, Malaysia is facing urban solid waste management issues as landflls are rapidly filling up, increasing amount of waste are generated, shortage of disposal land, resulting of serious environmental and human health impacts. These circumstances happened due to the growing amount and the variety types of waste generated in relation with the rapid population and industrial growth, and also due to the rising in the standard of living of the people. Landflling is the most widely used method for solid waste disposal, because it is the most economical and environmentally acceptable method throughout the world.

Historically, landflls have created various environmental problems and thus, the public has become more aware concerning landfll issues such as increasing concern on the groundwater contamination and potential release of toxic gases and odor. These impacts of associated problems could be minimized by reducing of solid waste volume (Nasir 2004). Composting is a controlled biological process that uses natural aerobic processes to increase the rate of biological decomposition of organic materials. It is carried out by successive microbial populations that break down organic materials into carbon dioxide, water, minerals and stabilized organic matter. Carbon dioxide and water are released into the atmosphere, while the minerals and organic matter are converted into a potentially reusable soil-like material called compost. The loss of water and carbon dioxide typically reduces the volume of remaining material by 25–60% (Renkow,etal 1994). The significant volume reductions associated with composting and the possible uses of compost make MSW composting

attractive as a potential means of diverting waste from landfills. On the other hand, MSW composting requires considerable presorting of the incoming waste and screening of the finished product to remove uncomfortable materials such as glass, metal and plastic—activities that tend to be relatively costly. The two basic processes used in large-scale composting are windrow-based technologies and in-vessel technologies. In windrow systems, waste is brought to a central open air facility and formed into windrows that are 3–5 feet high. The windrows are turned periodically to maintain a stable temperature and rate of decomposition, and water is added as needed to maintain appropriate moisture content. After a desired level of decomposition is reached, the composted product is ready for assembly and distribution to end users. A somewhat more sophisticated alternative to the simple windrow system is the aerated windrow system (Hamoda and Abu 1998).

METHODOLOGY

In this study, a composting plant has been chosen that situated at Jalan Seri Kembangan-Puchong, down south of Kuala Lumpur that converts biodegrades market and factory organic waste. I.e. fruit and vegetable waste to turns them into a valuable organic fertilizer. These composts are made from blends of vegetables and fruits. Materials are sliced and assembled in windrows. Effective Microbes is then splashed onto the organic matter, and it is then monitored for temperature and oxygen supply. Windrows are turned as needed and composts are tested for maturity before grinding and screening. Screened compost is run through a 5mm screen to filter out larger chunks. This product shall be applied as a source of fertility and life in soil.

5 tons of waste enters to this plant daily, after processing during 45 days all waste converts to compost. Total space is 2 acre, and 5 labors work at 9am to 5 pm. In this study, all input (organic waste from market) and outputs are measured during 7 days at 9-12am that average results of that is explained in table5.

COMPOST POTENTIAL IN MALAYSIA

Despite the aggressive economic development in Malaysia, the solid waste management is relatively poor and haphazard. Waste minimization strategy and control for the coming few years in Kuala Lumpur is the objective, to achieve the UN Agenda 21 which emphases on human and environment. In 1979 Environment Protection Society Malaysia (EPSM) called for an official policy for recycling and recovering solid wastes; moreover, (EPSM) statement recommended separation of wastes component at its generation point, separated waste must be placed in separate containers and organic waste should be used in biogas plant for composting and or for energy generation. Domestic rubbish collection was far from satisfactory (Nesadurai 1998). The quantity of waste generation in Kuala Lumpur was estimated by Sivapalan from 3070 tons per day in 2002 to 3478 ton per day in 2005 (Sivapalan,et al 2003)and was calculated 2% increase by Nasir Hassan around 4275 ton per day In 2010(Nasir 2004). Solid waste management in Malaysia is governed under concurrent list of the 9th schedule of the federal constitution. Under this list public health and sanitation can be carried out by the Federal government, state and also the local authorities that include collection, transportation, treatment and disposal of wastes. Economic growth in Malaysia has brought prosperity; it has started to impose costs of industrial pollution and degradation of the urban environment. In Malaysia planning and management of solid waste are under the responsibility of local

government and its departments that deal with urban cleansing and services. Solid waste management can be defined as the discipline associated with the control of generation (Tchobanoglous,etal 1993). Table 2 shows solid waste composition of selected locations in peninsular Malaysia (Wahid,et al 1996).

Table 1: MSW characteristics generated in Kuala Lumpur (Sivapalan,et al 2003)

Composition	Weight%	Approximate analysis (wet)	Weight%
Organics/Food	51.94	Moisture content	55.01
Paper	11.23	Volatile matter content	31.36
Plastics	20.97	Fixed carbon content	4.37
Wood	1.80	Ash content	9.26
Rubber	0.68	Elemental analysis (dry)	46.11
Textile	1.58	Carbon content	6.86
Yard	4.50	Hydrogen content	1.26
Glass	2.54	Nitrogen content	28.12
Aluminium	0.24	Oxygen content	0.23
Ferrous	2.28	Sulfur content	17.06

Table 2. illustrates the solid waste composition from 1975 to 2000 (Sivapalan,etal 2003)

Composition of waste	Residential high Income (%)	Residential medium Income (%)	Residential low Income (%)	Commercial (%	Institutional (%)
Organic	30.87	38.42	54.04	41.48	22.36
Paper	17.17	17.75	11.62	18.59	16.7
Plastic (rigid)	3.85	3.57	1.90	3.56	3.56
Plastic (Film)	21.62	14.75	8.91	12.79	11.82
Plastic (foam)	0.74	1.72	0.85	0.83	4.12
Wood	5.83	1.39	0.86	0.96	9.84
Textile	1.43	3.55	5.47	1.91	4.65
Glass	2.75	4.09	1.30	4.72	0.52
Metals	2.27	3.13	2.64	2.72	3.79
Others	13.47	11.63	12.41	12.96	22.64
Total	1000	100	100	100	100

Table 2. Composition of municipal solid waste in several years in Kuala Lumpur

Table 2 illustrates organic waste, has high contribution by the residential sector (up to 60%) but low contribution by the institutional sector (about 25% only). By visual observation during the sorting process, the amount of paper waste that came in from the institutional sector was much more when compared to that coming in from the other sources. This could be the reason for the large variance in the maximum and minimum range.

Plastic film, there is a difference in the amount of plastic film waste which is generated by the three different residential sectors. It could be concluded that income has a direct impact on the amount of plastic waste that is generated, as it clearly shows that the high-income people throw away the maximum amount of plastic waste, whereas the low-income people throw away the least.

Parameter	Assumption
Rate of population increase	4% per year
MSWG per person	1.50 kg per day
Rate of increase of SWG per person	2% per year
Total waste per house with 3.5 person per house	5.25 (1.5 * 3.5) kg per house per day
Volume of waste per house per day with bulk density = 100 kg/m3	100.00 m3
Frequency of MSW Collection	Three times per week
Total MSW in Kula Lumpur per week	7 tons
Population of Kuala Lumpur in 2004	2 million (including foreigners)
The share of recyclable material	20%

Table 3. miscellaneous assumptions

The predicted results of total solid waste generated (per day and per year) are showed in Table 4 For instance, the Municipal Solid Waste Generation (MSWG) in column 4 for a population of 2.34 millions in 2008 is 3798.9 tons/day. This figure is similar to the data which states that, if the current waste generation trends continue increasing at 2% rate per/year the waste generation will reach 3478 tons in 2005 (Nasir 2004).

Year	Population of KL city millions	MSWG Kg/Cap./day	MSWG tons/day	MSWG tons/year
2008	2.34	1.62	3798.88	1383642.0
2010	2.53	1.69	4274.86	1560323.9
2012	2.74	1.76	4810.49	1755828.9
2014	2.96	1.83	5413.23	1975828.9
2016	3.20	1.90	6091.49	2223393.9
2018	3.46	1.98	6854.73	2501976.5
2020	3.75	2.06	7713.61	2815467.7

Table 4. Prediction of total MSW generation in Kuala Lumpur

After measuring and considering of inputs and outputs of waste and compost in case study plant, results are shown in table 5.

	First day	Second day	Third day	Forth day	Fifth day	Sixth day	Seventh day	average
Input (kg)	4655	4753	4707	4832	4988	4925	4490	4650
Output	780	812	838	823	837	841	650	735

(kg)								

Table 5. Inputs and outputs of Sri Kenbangan composting plant during the experiment

Facilities and costs of compost production are shown in table 6.

ECONOMICAL CONSIDERING OF COMPOST PRODUCTION IN MALAYSIA

Items	Information
name of this composting technology	Simple wind row
space of site	2acer
capacity	5 tons / day
Amount of product	22 ton / month
Time processing	45 days
Number of labors	5 people
Number of staff	2 people
Electricity cost	700 RM[1] (228 US $)/month
Water cost	200 RM (65 US $)/month
Tipping fee	2000 RM (650 US $)/month
Maintenance cost	2000 RM (650 US $)/month
Salary	5000 RM(1629 US $)/month
Total price of plant	1500000 RM (488600 US $)
Material and fuel using	EM enzyme , bag , diesel ,oil
Transportation	1 lorry
Equipments	2 cutting machines 2 screening machines 1 packing machine

Table 6. Facilities and condition of composting plant in Sri Kenbangan

This information showas that total quantitative benefit of this plant is not much higher than the total quantitative cost, in other words, the total benefit of this plant is around 3000 RM (977 US $) per month that is not a much benefit for this plant.

Related to all information and calculating of total quantitative benefit and total quantitative cost, results show the quantitative total benefit of this plant is not much higher than total quantitative cost but this result is just for quantitative parameter such as: cost of salary, maintenance, electricity consumption, selling product and, etc.

This method has a lot of qualitative cost and benefits such as: reducing the amount of municipal solid waste, reducing transportation cost of carrying municipal solid waste to land fill, increasing life spam of land fill, reducing emissions of landfills, reducing leachate of landfill and, etc.

[1] All prices in this paper are changed from RM to US $ in date of 15 Oct 2010

CONCLUSION

Municipal solid waste in Malaysia has a large percent of organic waste (around 50-60 percent) that makes a lot of problems in disposal methods. High humidity in waste reduces energy value of waste and makes an extra cost in some methods like RDF plant and incineration for drying the waste before incinerating.

Increasing pressure and temperature in the pile of solid waste or landfill makes leachate from solid waste that if it would not under control might enter into the ground and surface water can be dangerous for human health. One of the best methods to solve these problems is sorting organic waste and treating that whit composting methods.

In this study, after considering of total cost and benefit of using composting method have been shown that Compost can be used as a soil amendment in a variety of agricultural, horticultural or landscaping applications, so long as appropriate measures are taken to eliminate contaminants and impurities from the finished product, therefore, not only producing of composting can be control load of pollution and decrease water contaminate, but also can increase quality of soil and improve landscape and green area inside cities.

Because of problems rise from landfills in sanitation of urban such as surface water pollution, ground water pollution, odor, increase of harmful insects and animals, moving toward compost production can be one of the most suitable tools to achieve a sustainable activity and make a green city.

Composting organic materials that have been diverted from landfills ultimately avoids the production of methane and leachate formulation in the landfills. Compost has the ability to prevent pollutants in storm water runoff from reaching surface water resources. Compost has also been shown to prevent erosion and silting on embankments parallel to creeks, lakes, and rivers, and prevents erosion and turf loss on roadsides, hillsides, playing fields, and golf courses. Using compost can reduce the need for water, fertilizers, and pesticides. It serves as a marketable commodity and is a low-cost alternative to standard landfill cover and artificial soil amendments. Composting also extends municipal landfill life by diverting organic materials from landfills and provides a less costly alternative to conventional methods of remediating (cleaning) contaminated soil.

However, expanding of this treatment method in Malaysia closely related to economic governmental supports.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the all the parties involved in making this study possible, particularly management and staff of market composting plant of Sri Kenbangan for the information and data related to my study.

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